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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/887,035	06/25/2001	Ramkumar Subramanian	039153-0381	7414

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David A. Blumenthal
FOLEY & LARDNER
Washington Harbour
3000 K Street, N.W., Suite 500
Washington, DC 20007-5109

EXAMINER

SAGAR, KRIPA

ART UNIT PAPER NUMBER

1756

DATE MAILED: 11/19/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/887,035

Applicant(s)

SUBRAMANIAN ET AL.

Examiner

Kripa Sagar

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 September 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-38 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 33-38 is/are allowed.
- 6) ☒ Claim(s) 1-11, 13-20, 22-30 and 32 is/are rejected.
- 7) ☒ Claim(s) 12, 21 and 31 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 June 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-11,13-20,22-30,32 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Pat.6218089 to Pierrat in view of US Pat.6337162 to Irie and further in view of US PG PUB 2002/0001758 to Petersen and further in view of US Pat. 6309800 to Okamoto.

The instant claims recite patterning a photoresist layer over a first layer, with two dissimilar masks under differing illumination conditions. The first mask may comprise dense patterns while the second mask may comprise isolated patterns. The illumination conditions include focus, numerical aperture, partial coherence and the like. The exposed photoresist is patterned and the pattern is transferred to the first layer. The etched first layer is filled with a conductive material. Semiconductor devices may be built up by this process. The process windows for the two exposures do not overlap.

~~The instant claims are taught by Pierrat whose teachings have been discussed,~~
with specific citations, in the earlier office action with reference to claim 1. It teaches conventional photolithographic processes of forming a photo-resist layer over a substrate, exposing and patterning it with a mask and transferring the pattern to a lower layer (1;58-2;6). It teaches diverse methods of patterning dense and isolated features

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with improved image fidelity. In one embodiment the dense features on a mask are exposed with a first optimal exposure setting; isolated features on the mask are again exposed with a second setting optimized for those features (4;29-50). Pierrat explicitly teaches exposure with two masks on the same resist (4;13-22). Pierrat teaches semiconductor device formation (cl.13,22,32). The device would perform as well as the claimed device, although it is formed by a different process. It is noted that no unique structural feature or property of the device formed by the instant process has been specified or claimed

Pierrat teaches overlay exposures with multiple masks; but it does not teach separation of features by pitch on to two or more masks. It does not teach non-overlapping process windows. It does not teach built-up multilayer devices.

Irie teaches a method of forming a pattern by multiple exposures of sub-patterns (Fig.1). It teaches that the sub-patterns may be formed based on the pitch. Dense patterns may be formed on one mask while isolated features are formed on another mask (22; 23-28). Irie teaches that the exposure conditions may be optimized for each mask (22;30-36). Irie teaches stitching of patterns during overlay exposures through multiple masks (5;56-6;23).

Irie does not discuss process windows or device fabrication.

This is demonstrated by Petersen, wherein masks with two different pitches (400nm and 600 nm) have non-overlapping process windows (Fig.19C,D). In another embodiment two masks are designed with a common process window (Fig.21I). The choice would be guided, among other factors, by the exposure apparatus and process

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flow. It may be noted that Petersen teaches focus as an exposure variable (#0152; last line) suggesting that dense and isolated patterns may not have a common process window even if the CD (critical dimension) is the same.

Petersen does not teach a built up multilevel device.

Okamoto teaches this as discussed in the previous office action.

The combination of Pierrat, Irie, Petersen and Okamoto lead to the instant invention. This combination would have been obvious to one of ordinary skill in the art for the following reasons: Pierrat, Irie, and Petersen attempt to solve the same problem viz. patterning dense and isolated features on a photoresist with true image fidelity. The three references teach the separation of isolated and dense features and exposure with optimal illuminating conditions. Irie and Petersen teach separating the features on two or more masks for multiple exposures because Petersen realizes that there may be no common focus, exposure conditions for the two (#0152) while Irie teaches that separation on two or more masks facilitates optimizing the exposure conditions (22;23-63). Okamoto teaches a conventional method of successfully forming devices with multiple levels of metallization using the processes similar to Pierrat's, Irie's and Petersen's.

Allowable Subject Matter

3. Claims 33-38 are allowed.
4. The following is an examiner's statement of reasons for allowance:

Claim 33 recites an exposure method for dense and isolated features wherein the process windows for the two exposures do not overlap. The teachings of Petersen

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were used in prior office action to reject the claims. Examiner notes that although Petersen teaches that process windows for different pitches may not overlap as stated in the prior rejection (reproduced and modified above) it does not explicitly recommend multiple exposures with non-overlapping process windows. To the contrary, Petersen teaches modifying the masks *to find a common process window* (p.9;#0153). It is conventional in the art to find a *common process window* even with multiple mask exposures, because this reduces the set-up time.

Claims 34-38 are allowed for depending from claim 33.

5. Claims 12,21,31 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: These claims recite non-overlapping process windows and are similar to claim 33.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Response to Arguments

6. Applicants' request to reconsider the previous rejection has been received; the patentable claims have been indicated as result of a review. Applicant's arguments

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against the references are not persuasive and the prior rejections are maintained on indicated claims.

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Applicants arguments individually against the references are not convincing. Thus Pierrat teaches exposure on the same resist through two masks; Irie teaches separation of features on two or more masks, based on feature density and multiple exposures through the masks. Irie teaches *stitching* of patterns which, a technician of ordinary skill in the art would know, occurs on the same layer. Examiner disagrees that Irie's teachings are solely applicable to mask making – for Irie teaches exposing the multiple masks on a *device substrate* (9;47) in contrast to a *mask substrate* widely referred to throughout the reference. That the masks *may be* used to expose different layers or different substrates is a spurious argument and not persuasive.

In arguing against the combination of Irie and Petersen with Pierrat, Applicant has selectively interpreted Pierrat's invention to reverse-toned mask pairs. As shown above, the broad case of exposure with two different masks on the same resist is explicitly stated by Pierrat. Further, the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references

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would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981). A skilled artisan would have immediately recognized the method of combining Pierrat's two-mask method with Irie's separation of features on two masks. The motivation for combining has been stated above.

Claims 13,22,32 recite a product by process and are not patentable; cancellation of these claims is recommended.

Conclusion

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kripa Sagar whose telephone number is 703-605-4427.

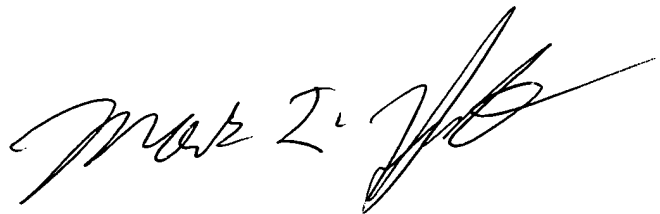
The examiner can normally be reached on M-F.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark F Huff can be reached on 703-308-2464. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

MH/ks

A handwritten signature in black ink, appearing to read "Mark F. Huff", with a stylized flourish at the end.

MARK F. HUFF
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700